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On-Board Diagnostic Hand-Held Scan Tool Technology:

Adherence to the Society of Automotive Engineers Requirements for Scan Tools and an Evaluation of Overall Scan Tool Capability

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DISCLAIMER

The following report is for informational purposes and is property of the U.S. Environmental Protection Agency (EPA). This report is not intended to be an EPA endorsement for any manufacturer participating in this evaluation, a marketing exercise, nor a determination for the ability to repair a vehicle using a hand-held scan tool. Any attempt to use this report in this manner is inappropriate and a misrepresentation, and may result in legal action.

This report deals with hand-held scan tool functions related to On-Board Diagnostic Systems, emission-related parameters and/or the display of emission-related engine parameters. In addition, this report only examines a partial set of the possible hand-held scan tool functions. For more detailed information, you should contact the manufacturer directly or visit the manufacturer's website included at the top of the scan tool product information pages (where available) in Appendix IV: "Scan Tool Product Information."

Some of the information in this report was received from the participating companies in this scan tool evaluation. If companies did not respond or were not able to be contacted, their scan tool is not included in this report. Also, at the time of publication, some of the information was not available and, therefore, this information is purposely omitted and will be included in future report updates. You may find information on the scan tool manufacturers included in this report, other manufacturers of hand-held scan tools, and other automotive repair equipment through the Equipment and Tool Institute (ETI, www.etools.org).

Thank you.

1. Abstract

In order to address concerns about On-Board Diagnostics (OBD) equipment capability and the interaction of service technicians with OBD equipped vehicles, EPA evaluated current OBD hand-held scan tool technology. A variety of OBD hand-held scan tools were acquired from aftermarket scan tool and original equipment manufacturers (OEM), and evaluated against the SAE requirements for OBD hand-held scan tools. Also, in response to the public, EPA collected and is providing additional information on additional features and characteristic information about each OBD hand-held scan tool used in this evaluation. This report summarizes this information and provides a brief overview of OBD hand-held scan tool requirements and features.

In summary, all of the scan tools evaluated in this study meet the basic requirements of a service technician, a state Inspection and Maintenance (I/M) Program, and a public consumer considering an OBD hand-held scan tool. The results of this evaluation demonstrate that the OBD hand-held scan tools examined adhere to the SAE requirements for an OBD hand-held scan tool and also provide many additional features. One scan tool in its original configuration does not support SAE J1979 Modes 6, the latest test results for non-continuous monitors, but this function is available via free software upgrade from the manufacturer.

As a whole, the OBD hand-held scan tools are inconsistent with respect to readiness status nomenclature (see Appendix III: "Readiness Status Chart" for more detail) which can cause confusion in I/M lanes or first-time users. Efforts should be made to standardize the readiness status nomenclature on OBD hand-held scan tools.

Also, when comparing the engine parameters displayed on an aftermarket scan tool to an OEM scan tool, we found that the aftermarket scan tools and the OEM scan tools had comparable numbers of engine parameters listed in both generic and enhanced (i.e., manufacturer-specific) mode (see Appendix II: "Engine Parameters" for more detail).

Our evaluation of scan tool characteristics demonstrates that each scan tool is unique in terms of the physical design, delivery format and display of information, and the additional features that are offered (see Appendix IV: "Scan Tool Product Information" for more details or check the manufacturers' website). Thus, the distinguishing factors are subjective in nature and it is up to the individual purchaser to determine the characteristics they require when choosing a scan tool. However, this evaluation can assure them that, at a minimum, the basic requirements for an OBD hand-held scan tool have been met.

2. Introduction

In the early 1980s, automobile manufacturers began using electronics and on-board computers to control many of the engine functions. The increasing complexity of vehicle technology led manufacturers to develop ways to effectively diagnose vehicle problems as a result of new electronic hardware. Thus, the earliest form of vehicle on-board diagnostics was developed by auto manufacturers to decrease the down-time spent diagnosing vehicles.

In 1989, CARB issued regulations requiring the second generation of OBD regulations, often referred to as OBDII. CARB required OBDII systems on 1994 and later MY light-duty vehicles and trucks, and medium-duty vehicles and engines sold in California. In 1990, Congress finalized the Clean Air Act Amendments including a mandate to the Environmental Protection Agency to develop regulations requiring OBD systems on all 1994 and newer vehicles sold nationwide and known as Federal OBD. These regulations expanded the list of components that were monitored to include emission-related components and added a self-diagnosing function that evaluated component condition beyond the simple connectivity and pass/fail checks that previously existed on first generation OBD or OBD I vehicles. This further increased the complexity of vehicle technology but also added significant amounts of information available to diagnose vehicle problems.

Due to these advances, it became more imperative to have equipment capable of communicating effectively with the vehicle OBD system and delivering this information to the technician. It was deemed necessary to standardize many aspects of the OBD system, including such things as the data link connector, communication protocol(s), and nomenclature. The Society of Automotive Engineers (SAE) developed these standardized methods or recommended practices to provide implementation guidance and design requirements for vehicle manufacturers complying with the OBD requirements and equipment and tool manufacturers developing service equipment, and to ensure vehicle and equipment compatibility. Some of these standards are referenced in the OBD Regulations making them a requirement for manufacturers to follow, such as the standards for scan tool operation.

As a result of this SAE initiative and the advances made in computer technology, a new generation of hand-held scan tool was developed to interact with the OBD II/Federal OBD systems. The hand-held scan tool became more powerful in terms of storage, processing, and display; and assumed a more prominent role in the diagnosis of vehicle component malfunctions. Thus, the hand-held scan tool became one of the primary links to proper diagnosis and repair of OBD equipped vehicles.

With these developments, the United States Environmental Protection Agency (U.S. EPA) decided to evaluate OBD hand-held scan tool technology. A previous evaluation was conducted in 1996-1997 to examine compliance with SAE recommended practices (SAE J1978 and J1979) and the number of engine parameters available on OBD hand-held scan tools. The results of the previous evaluation were presented at the 1998 SAE International Congress and Exposition in a Service Technicians Society (STS) session entitled "OBD II: A User's Perspective." However, several questions were raised by the audience about other scan tool capabilities and were beyond the scope of the previous evaluation. In addition, as we consider utilizing OBD in Inspection and Maintenance (I/M) Programs, there is increasing concern about OBD vehicle and equipment interaction/compatibility. Therefore, this evaluation expands the scope beyond that of the previous OBD hand-held scan tool evaluation, and this report discusses the methodology used to evaluate the scan tools and the results of our evaluation.

3. Scan Tool Selection

Scan tools were selected from the aftermarket manufacturers and the OEMs based on knowledge of companies in the scan tool market. In addition, a search of Equipment and Tool Institute (ETI) membership revealed information on additional aftermarket scan tool manufacturers. Out of the many aftermarket scan tools available on the market, we were able to acquire the following eight:

- Actron Kal-Equip 9615
- Auto Xray EZ-Link OBDII Scanner
- Blue Streak Electronics BDM Pro Diagnostic Monitor
- Interro Systems PST 500
- Matco Tools Determinator
- MPSI Pro Link 9000
- SPX-OTC Monitor Enhanced 4000
- Vetronix Corporation Mastertech

The OEM scan tools provide a good contrast to the aftermarket scan tool since the OEM scan tools are designed for a manufacturer specific vehicle. Therefore, the following OEM scan tools were used for the evaluation with the manufacturer of the scan tool in parenthesis where available:

- Chrysler DRBIII (SPX-Miller)
- Ford New Generation Star Tester (Hickok)
- General Motors Tech II/SPX-OTC Tech 2 Flash (Hewlett-Packard)
- Toyota Diagnostic Tester (Vetronix).

4. Vehicle Selection

The vehicles used in the evaluation were originally selected from a vehicle Fleet available at the EPA's NVFEL. These vehicles are provided to private vehicle owners in exchange for their vehicle's participation in an emissions program. Originally, the following vehicles were used from this fleet:

- 1997 Buick LeSabre
- 1996 Chevy Lumina
- 1996 Dodge Intrepid
- 1996 Ford Taurus Wagon

However, this list was expanded as new test programs on OBD equipped vehicles were developed. Approximately forty-eight 96 or newer, OBD-equipped employee vehicles were identified at the NVFEL and utilized for these test programs. Each scan tool was not evaluated on all of the forty-eight vehicles but on average, was used with 5-10 different vehicles for the purposes of coverage. The following is a summary of the employee-owned vehicles used with the number of vehicles in parenthesis:

- Audi/VW (2)
- Daimler-Chrysler (11)
- Ford Motor Co. (12)
- General Motors (13)
- Honda (3)
- Mazda (1)
- Toyota (5)
- Volvo (1).

5.   SAE Requirements for OBD Scan Tools

Compliance with the SAE standards provides scan tool compatibility with OBD equipped vehicles and addresses concerns about OBD equipment, in particular hand-held OBD scan tools. As mentioned in the introduction, SAE has developed guidelines to facilitate the standardization of OBD vehicle technology, information and equipment. In particular, the SAE standards for OBD hand-held scan tools that were considered in conducting this evaluation are as follows:

- J1962 - describes the standardized 16-pin trapezoidal connector

- J1978 - describes the basic functions that an OBD Scan Tool will support:

  - Automatic hands-off determination of the communication protocol

  - Obtaining and displaying the status and results of vehicle on-board diagnostic evaluations (supported and completed readiness tests and malfunction indicator lamp (MIL) status)

  - Obtaining and displaying -

    - diagnostic trouble codes (DTCs)

    - emissions related current data (i.e., engine parameters)

    - emissions related freeze frame data

    - latest test parameters and results (i.e., Mode 6 of SAE J1979)

    - other emission related test parameters and results as described in SAE J1979

  - Clearing stored emissions related DTCs, freeze frame data and diagnostic test results

- J1979 - describes diagnostic test modes for emission related diagnostic data that is

displayed by all scan tools and are as follows:

- ► Mode #1 - Request for current powertrain diagnostic data including: engine parameters, MIL status and readiness codes

- ► Mode #2 - Request for powertrain freeze frame data

- ► Mode #3 - Request emission-related powertrain diagnostic trouble codes (DTCs)

- ► Mode #4 - Clear/Reset emission-related diagnostic information including MIL status, DTCs, freeze frame and readiness codes

- ► Mode #5 - Request oxygen sensor monitor test results

- ► Mode #6 - Request latest on-board monitoring test results for non-continuous monitor systems (i.e., catalyst, exhaust gas re-circulation (EGR), evaporative system, etc.)

- ► Mode #7 - Request latest on-board monitoring test results for continuous monitor systems (i.e., fuel trim, misfire, comprehensive components)

- • J1850, ISO 9141-2 and ISO 14230-4 - describes the various communication protocols and message formats that a manufacturer may use when developing and implementing the OBD software on a vehicle

- • J2012 - describes the recommended standardization of numeric DTCs and the descriptions accompanying the DTCs.

For more information on OBD requirements, refer to "SAE On-Board Diagnostics for Light and Medium Duty Vehicles Standards Manual - 2000 Edition."

6. Additional Scan Tool Functions

In addition to the SAE requirements, some additional functions were considered and evaluated but are not required. This is not a complete list of scan tool functions but a cross-section of common functions that were brought to our attention or might be encountered. The additional functions included but are not limited to:

- • Additional LEDs - scan tool has lights adjacent to the screen that change as engine values change on the screen; this allows a technician to be aware of engine changes if they are unable to see the values on the screen

- Bi-directional Control - scan tool can control certain vehicle components or initiate systems tests on command

- Graphical Display - scan tool can display real-time engine parameters or recorded data in graph (bar or line) format

- Heavy Duty Applications - scan tool can work on Medium Duty (8,500 - 14,000 lbs. GVWR) or Heavy Duty Vehicles (>14,000 lbs. GVWR)

- Help Menu/Trouble Code Library - scan tool can guide a technician through certain procedures or has a built-in library of all the SAE generic trouble codes
- Printer/Computer Output - scan tool connects to a printer or computer and prints or displays information from the vehicle

- Record/Playback or Snapshot Mode - scan tool can record a block of real-time engine data and replay that information in order to root cause a malfunction

- Reprogramming of Vehicle PCM- scan tool can perform off-board or on-board reprogramming of a vehicle's computer modules, specifically the powertrain (PCM)

- Scopes and Meters - scan tool can operate as a multi-meter (measure voltage, resistance, current, etc.) or an oscilloscope

- Troubleshooting/Diagnostic Aid - scan tool provides additional information that can aid in diagnosing a problem, typically a library that describes common failure modes and components associated

Many scan tools offer software for vehicle systems other than Engine and Powertrain such as Anti-lock Brake, Transmission, Chassis and Body. For more details, you should contact the manufacturer directly or visit their website that has been included (where available) on the product information sheet in Appendix IV: "Scan Tool Product Information" for each scan tool.

7.   Additional Scan Tool Information

Before and during the course of this evaluation, queries about OBD hand-held scan tool cost and general needs, such as vehicle coverage, have been raised. In order to be as useful and informative as possible, EPA decided to gather this information and include it in this report. This information is detailed separately in Appendix IV: "Scan Tool Product Information." and includes the following information:

- Scan tool dimensions

- Scan tool weight

- Scan tool screen dimensions

- Screen display characteristics

- Power supply/voltage ratings

- Operating/Storage temperature

- Approximate price range of scan tool (basic version - full capability)

- Additional functionality

- Additional equipment

- Vehicle coverage

For more details, you should contact the manufacturer directly or visit their website that has been included (where available) on the product information sheet in Appendix IV: "Scan Tool Product Information" for each scan tool.

8.   Results

The next two pages are the tabulated results of adherence to the SAE standards (Figure #1) and the features of the OBD hand-held scan tools (Figure #2) used in this evaluation. Additional data on the OBD hand-held scan tools used in this evaluation can be found in Appendix II, "Engine Parameters" and Appendix III, "Readiness Status Chart," and individual scan tool characteristics can be found in Appendix IV, "Scan Tool Product Information." Also, for more details, you should contact the manufacturer directly or visit their website that has been included (where available) on the product information sheet, in Appendix IV: "Scan Tool Product Information," for each scan tool.

OBDII PARAMETERS: SAE Requirements ⇒ Scan Tools	J1962 - Standardized Connector	J1978 - OBDII Scan Tool Functionality	J1979 - Diagnostic Test Modes (1-7)	J1850, ISO9141-2 & 14230-4 - Communication Protocols	J2012 - Standardized DTC usage	COMMENTS
Actron KAL-Equip 9615	X	X	X	X	X	
Auto Xray EZ-Link Scanner	X	X	X*	X	X	*Lacks Mode 6 (latest test results for non-continuous monitors) *available through free upgrade*
Blue Streak Electronics BDM Pro Diagnostic Monitor	X	X	X	X	X	
Chrysler DRBIII	X	X	X	X	X	
Ford New Generation StarTester (NGS)	X	X	X	X	X	
GM Tech 2 & SPX-OTC Tech 2 Flash	X	X	X	X	X	
Interro Systems PST 500	X	X	X	X	X	
Matco Tools Determinator	X	X	X	X	X	
MPSI Pro Link 9000	X	X	X	X	X	
SPX-OTC Monitor Enhanced 4000	X	X	X	X	X	
Toyota Diagnostic Tester	X	X	X	X	X	
Vetronix Corp. Mastertech	X	X	X	X	X	

Figure #1: SAE Requirements for OBD-equipped vehicle communications and OBD scan tools.

OBDII PARAMETERS: Features →	Actron KAL-Equip 9615	Auto Xray EZ-Link Scanner	Blue Streak Electronics BDM Pro Diagnostic Monitor	Chrysler DRBII	Ford New Generation Star Tester (NGS)	GM Tech 2 & SPX-OTC Tech 2 Flash	Interro Systems PST 500	Matco Tools Determinator	MPSI Pro Link 9000	SPX-OTC Monitor	Toyota Diagnostic Tester	Vetronix Corp. Mastertech
Trouble Shooting/ Diagnostic Aid	'	'	X	X	X	'	'	'	'	'	'	X
Scopes and Meters	'	'	X	X	X	'	'	'	'	X	X	X
Reprogramming of Vehicle PCM	'	'	X	X	X	X	'	'	'	'	X	X
Record/Playback or Snapshot Mode	X	X	X	'	X	X	'	X	X	X	X	X
Computer/Printer Output	'	X	X	X	X	X	'	X	X	X	X	X
Help Menu/ DTC Library	X	X	'	'	X	'	X	X	X	'	X	X
Heavy Duty Applications	'	'	'	'	X	X	'	'	X	'	'	X
Graphical Display	'	'	X	'	X	'	'	'	'	'	X	X
Bi-Directional Control	X	'	X	X	X	X	'	X	'	X	X	X
Additional LED Display	'	'	X	'	'	'	'	'	'	X	X	X

Figure #2: Additional OBD hand-held scan tool features selected for this evaluation.

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9.   Observations and Future Considerations

9-1   Vehicle Communications

There have been external reports of communications problems but during our evaluation, we did not experience any. The only communication problems encountered were attributed to our scan tool's software version and, once it was updated to the latest version, performed properly. Although the SAE protocols are specified, communication speeds increase from model year to model year. As a result, there is a need to ensure that scan tools have the latest software version to maintain pace with vehicle technology. In addition, certain manufacturers have deviated slightly from the complex specifications for the SAE communication protocols and some incompatibility may occur until scan tool manufacturers can compensate for this deviation in sub-sequent software updates. Therefore, vehicle communications can also be a function of the scan tool or of the vehicle design, but can be remedied through software upgrade.

9-2   Readiness Status Nomenclature

As a group, the OBD hand-held scan tools do not use consistent nomenclature when readiness status. Many of the scan tools do not distinguish between continuous monitors (misfire, fuel trim, comprehensive components) and non-continuous monitors (catalyst, oxygen sensor, evaporative system, EGR) (see Appendix II: "Additional Scan Tool Data" for further detail). SAE J1979 defines the system status information that must be displayed, including readiness codes, and distinguishes between continuous and non-continuous monitors. While this is not a significant issue, there is the potential for confusion when using the hand-held scan tool to review information. This situation has already occurred in a state OBD-I/M pilot program currently being performed. More consideration should be devoted to developing a consistent nomenclature for readiness status.

9-3   Data Stream Update Rates

There is a mis-conception that the OEM scan tools have a faster data stream update rates than aftermarket scan tools causing the incorrect conclusion that the OEM scan tools are more powerful than the aftermarket scan tools. However, OEM proprietary data link(s), or enhanced data, and their messaging techniques provide the ability for a scan tool to send and receive data at a much faster rate than the legislated data link(s) and their messaging technique. Therefore, it is a difference between generic and enhanced data, and not a difference between OEM and Aftermarket scan tools.

In addition, the update rate of the scan tool is dependent on the protocol used by the vehicle manufacturer. Some protocols are slower than others and, since aftermarket scan tools must support all of these different protocols, there may be a slower update rate depending on the communication protocol the vehicle uses.

Also, tailoring the data list to only the parameters needed or the parameters that change more frequently will increase the update rate. This is tied to the speed at which data can be requested and received from the vehicle computer data link: the more parameters requested, the longer the time between the first parameter in the list to update to the last parameter in the list to update.

In summary, the difference in data stream update rate is more of a function of user application rather than scan tool ability.

10. Conclusions

The current OBD hand-held scan tools meet the SAE basic requirements, have many additional features and should be acceptable for use by a service technician or an I/M program in a centralized or de-centralized arena.

Many hand-held scan tool manufacturers are developing OBD PC-based scan tools that have the same functionality as a OBD hand-held scan tool coupled with the increased power and flexibility of a desktop or laptop computer. Since the hand-held scan tool serves as the foundation for this technology, the basic groundwork for PC-based scan tools exists and has proven to be effective.

11. Reference Materials

1. SAE On-Board Diagnostics for Light and Medium Duty Vehicles Standards Manual - 2000 Edition

2. Aspire, Inc. OBD Systems Inspection and Diagnostics Inspector Reference Guide
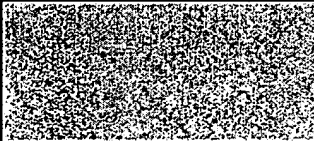
Appendix I
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Scan Tool Manufacturers

Actron: Bill Kilduff Tom Carter John D. Wiedemann Hamid Namaky	**Ford:** Timothy Bednark Gwendolyn Ald Marita Judson Roger Judson	**SPX Corporation:** Fred E. Kaleal Rob Kochie Jim Wanberg
Auto Xray, Inc.: William J. Miller	**General Motors:** William Wiegand	**Toyota:** Mark Saxonberg
Blue Streak Electronics: Aron Regev Fabian De Nobrega Jeff Elder	**Interro:** Kevin Ramsey	**Vetronix:** Bernard J. Carr Mark Hall
Chrysler: Chris Micha Rich Pershell Ray Williams	**MPSI:** Chet Taras Thomas Kotenko	

Appendix II
Engine Parameters

The previous scan tool evaluation determined compliance with the SAE recommended practices (SAE J1978 and J1979) for a scan tool and compared the number of engine parameters available between OEM and aftermarket scan tools. Figure #3 is a comparison of the engine parameters from that evaluation and applies only to the following scan tools:

- MPSI Pro Link 9000
- SPX-OTC Monitor Enhanced 4000
- Vetronix Corporation Mastertech
- Chrysler DRBIII
- Ford New Generation Star Tester (Hickok)
- General Motors Tech II (Hewlett-Packard)
- Toyota Diagnostic Tester (Vetronix).

VEHICLES	OEM (Enhanced/Generic)	AFTERMARKET (Enhanced/Generic)
1997 Buick LeSabre	81/26	70/20
1996 Chevrolet Lumina	60/33	42/27
1996 Ford Taurus Wagon	127/31	46/26
1996 Dodge Intrepid	49/30	44/25
1996 Honda Accord	--/25	--/19
1995 Toyota Camry	61/25	--/24
Group Average	**76/28**	**51/24**

Figure #3: Number of engine parameters in enhanced
and generic mode for OEM and aftermarket scan tools.

For the OEM scan tools, enhanced values were obtained by using the OEM scan tool on the manufacturer specific vehicle and counting (and/or summing) the number of engine parameters listed in the menus labeled "engine data" or similar terminology (duplicate parameters between multiple engine data menus were eliminated where possible). The generic values were obtained by placing the OEM scan tool into generic mode (if it was able to perform this function) on each non-manufacturer specific vehicle, counting the engine parameters, and averaging the values for all scan tools on each vehicle scanned. We were unable to acquire a Honda-specific scan tool so the enhanced space under the OEM tool is blank.

For the aftermarket scan tools, the values were obtained by entering enhanced (i.e., manufacturer specific) and generic mode, counting the engine parameters, and averaging the values for all scan tools on each vehicle scanned. During the previous evaluation, the Asian-specific software was unavailable and this portion is not part of the current evaluation. Therefore, the enhanced portion of the aftermarket scan tool under the Honda and Toyota vehicles is blank.

The numbers at the bottom of the chart represents the group average for all the scan tools in enhanced and generic mode. This data demonstrates that, on average, aftermarket scan tools are comparable to OEM scan tools in terms of delivering engine parameters.

Appendix III
Readiness Status Display of the Scan Tools

Figure #4 on the next page was adapted from the Aspire, Inc. "OBD Systems Inspection and Diagnostics Inspector Reference Guide." The chart that appeared in the Aspire, Inc. publication included the Interro PST500, OTC Monitor Enhanced 4000, Snap-On MT2500, Vetronix MasterTech and Tech 1A, and the EASE Simulation Quick Code." We have added the scan tools used in this evaluation that were not included in the Aspire, Inc. publication (with the permission of Aspire, Inc.).

Readiness Status Display of Various Scan Tools

Scan Tool	Continuous Monitors (misfire, fuel trim, comprehensive components) — Displays Ready As:	Non-Continuous Monitors — Displays Ready As:	Non-Continuous Monitors — Displays Not Ready As:	Unsupported Monitors — Displays Unsupported As:
Actron Kal-Equip 9615	"ok"	"ok"	"inc"	"n/a"
Auto Xray EZ-Link Scanner	"Completed"	"Completed"	"Not Completed"	"Not Supported"
Blue Streak Electronics BDM Pro Diagnostic	"CONT"	"RDY"	"NOT RDY"	Does not display unsupported monitors
Chrysler DRBIII	Does not display continuous monitors	"Completed"	"Not Completed"	"N/A"
Ford New Generation Star Tester	"CONT"	"YES"	"NO"	"N/A"
GM Tech 2/ SPX-OTC Tech 2 Flash	Does not display continuous monitors	"YES"	"NO"	Does not display unsupported monitors
Interro Systems PST 500	Monitor without "*"	Monitor without "*"	Monitor with "*"	Does not display unsupported monitors
Matco Tools Determinator	"ok"	"ok"	"inc"	"n/a"
MPSI Pro-Link 9000	"SUP"	"DONE"	"PEND"	"N/A"
SPX-OTC Monitor Enhanced 4000	"DONE"	"DONE"	"PEND"	"N/A"
Toyota Diagnostic Tester	"Available"	"COMPL"	"INCMPL"	"N/A"
Vetronix Mastertech	"Available"	"COMPL"	"INCMPL"	"N/A"

Figure #4: Readiness status Nomenclature for the scan tools in the evaluation.

Appendix IV
Scan Tool Product Information

Explanation of Measurements for Individual Scan Tools

All measurements listed for the individual scan tool properties are presented in English units and the International System of Units (SI) in parenthesis, where applicable. For the dimensions of the scan tool and scan tool screen, measurements were taken at the widest part of the scan tool as if a user were holding the scan tool. Also, many of the manufacturers provide detailed information on measurements and these are arranged to simulate a user holding the scan tool. The measurements are reported as follows:

      Scan Tool Dimensions: Height (**H**) x Width (**W**) x Depth (**D**)

      Scan Tool Screen Dimensions: Height (*h*) x Width (*w*)
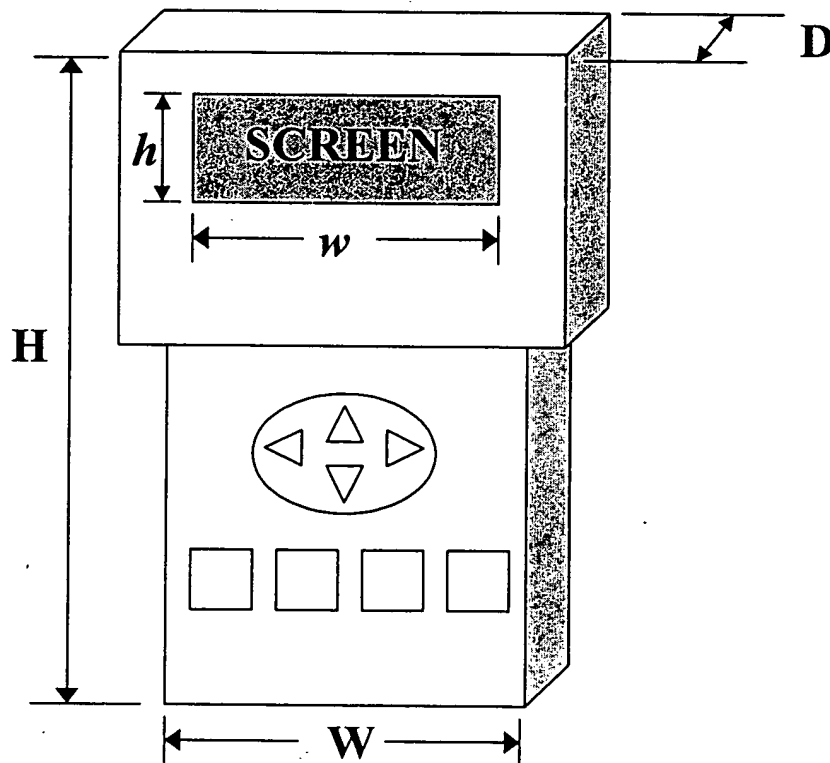
Measurements were acquired according to Figure #5 below:

Figure #5: Diagram of scan tool measurements.

Actron KAL-Equip 9615
www.actron.com

Scan Tool Properties

Scan Tool Dimensions:	7.6" x 4.0" x 1.4" (19 cm x 10 cm x 3.5 cm)
Scan Tool Weight:	1.1 lbs. (0.5 kg)
Scan Tool Screen Dimensions:	1" x 2.4" (2.5 cm x 6 cm)
Screen Display Characteristics:	4 lines, 20 characters/line, LCD
Power Supply/Voltage Ratings:	7.5 V - 16 V, DC
Operating/Storage Temperature:	14-122/ -4 - 158 °F (-10 - 50/ -20 - 70 °C)
Price Range:	$379.99

Additional Functionality

Additional Equipment

Vehicle Coverage

1996 - Current Year OBDII equipped vehicles	

Auto Xray EZ-Link Scanner
www.autoxray.com

Scan Tool Properties	
Scan Tool Dimensions:	7.3" x 3.8" x1.5" (18.4 cm x 9.5 cm x 3.8 cm)
Scan Tool Weight:	0.75 lbs. (0.34 kg)
Scan Tool Screen Dimensions:	0.6" x 2.4" (1.6 cm x 6 cm)
Screen Display Characteristics:	2 lines, 16 characters/line, LCD
Power Supply/Voltage Ratings:	4 AA batteries
Operating/Storage Temperature:	32-122 °F/ -4 - 158 °F (0 - 50 °C/ -20 - 70°C)
Price Range:	$199.99 - $449.99

Additional Functionality	
Internet Upgrade through PC Link	

Additional Equipment	
EZ Link XP240 Pro Pack (OBD I software)	PC Link System (computer output)

Vehicle Coverage	
1996 - Current Year OBDII equipped vehicles	1982-95 OBD I equipped domestic vehicles (Chrysler, Ford GM)

Blue Streak Electronics BDM Pro Diagnostic Monitor
www.bsecorp.com

Scan Tool Properties

Scan Tool Dimensions:	10" x4.9" x2.3" (25.4 cm x 12.4 cm x 5.9 cm)
Scan Tool Weight:	2.2 lbs. (1 kg)
Scan Tool Screen Dimensions:	4.1" x 3.1" (10.4 cm x 7.9 cm)
Screen Display Characteristics:	12 lines, 50 characters/line, LCD w/ Cold Flourescent Light (CFL) back-lighting
Power Supply/Voltage Ratings:	10 V - 16 V DC, 4 AA Batteries (alternate)
Operating/Storage Temperature:	32-122 / 68-140 °F (0-50 / 20-60 °C)
Price Range:	$2900 - $3200

Additional Functionality

Dual-channel Oscilloscope	Digital Multi-meter (volt, ohm, frequency)
Temperature Measurement	Current Measurement

Additional Equipment

Temperature Probe	Multi-Meter Probes (included with kit)
Printers- Thermal and Infrared	PC Link Software
Secondary Ignition Kit	Mastermind Chassis Cartridge
Amp Probe	BDM Domestic I Cartridge (OBD I vehicles) (included with kit)

Vehicle Coverage

1996 - Current Year OBDII equipped vehicles	1981-1995 General Motors 1983-1995 Chrysler and Ford

Chrysler DRBIII

Scan Tool Properties

Scan Tool Dimensions:	6.4" x 13.5" x 3.6" (16.3 cm x 34.3 cm x 9.1 cm)
Scan Tool Weight:	4.0 lbs (1.81 kg)
Scan Tool Screen Dimensions:	3.1" x 3.9" (7.9 cm x 9.9 cm)
Screen Display Characteristics:	12 lines, 32 (or 40) characters/line, LCD (240 x 320)
Power Supply/Voltage Ratings:	8 – 18VDC
Operating/Storage Temperature:	32 - 122 / -4 - 158 °F (0-50/ -20 - 70 °C)
Price Range:	$2600 - $4230

Additional Functionality

Dual-channel Oscilloscope	Digital Multi-meter (volt, ohm, frequency)
Temperature Measurement	Current Measurement
Pressure Measurement	

Additional Equipment

Pressure sensors & adapters	0 – 2000 Amp current probe (AC/DC)
Sonic belt tension adapter	Temperature Probe
0 – 10 Amp Shunt	Inclinometer Sensors (for Viper Alignments)
Scope cables (1x & 10x)	PCMCIA Cards (SuperCard, SuperCard2, ST-22 Support)

Vehicle Coverage

1983 - 2001 Chrysler/Plymouth/Jeep/Dodge and Captive (import 2-door coupe)	1996 - Current Year OBDII equipped vehicles

Interro PST 500
www.interro.com

Scan Tool Properties

Scan Tool Dimensions:	9" x 3.5" x 1.8" (22.9cm x 8.9cm x 4.5cm)
Scan Tool Weight:	1.3 lbs. (0.6 kg) .
Scan Tool Screen Dimensions:	1.8" x 2" (4.5cm x 5.1cm)
Screen Display Characteristics:	10 lines, 20 characters/line, LCD screen
Power Supply/Voltage Ratings:	7 V - 18 V; Nominal 12 V, 200 - 300 mA
Operating/Storage Temperature:	41-113 / 68-140 °F (5-45 / 20-60 °C)
Price Range:	$895

Additional Functionality

Additional Equipment

Vehicle Coverage

1996 - Current Year OBDII equipped vehicles	

Matco Tools MD 2001 "Determinator"
www.matcotools.com

Scan Tool Properties	
Scan Tool Dimensions:	8.2" x 5.2" x 1.8" (21cm x 13cm x 4.6cm)
Scan Tool Weight:	1.1 lbs. (0.5 kg)
Scan Tool Screen Dimensions:	1" x 3"(2.5cm x 7.6cm)
Screen Display Characteristics:	4 lines, 20 characters/line, LCD
Power Supply/Voltage Ratings:	7.5 V - 16 V, DC
Operating/Storage Temperature	14 - 122 / -4 - 158 °F (-10 - 50/ -20 - 70 °C)
Price Range:	$ 550.00

Additional Functionality	

Additional Equipment	
9 Volt Battery	Detachable cables for

Vehicle Coverage	
1994 - Current Year OBDII equipped vehicles	1994 - Current Year OBDII equipped GM, Ford, Chrysler vehicles (enhanced functions)

MPSI Pro-Link 9000
www.mpsilink.com

Scan Tool Properties

Scan Tool Dimensions:	8" x 5.3" x 2.8" (20.3cm x 13.3cm x 7cm)
Scan Tool Weight:	2.0 lbs. (1.0 kg)
Scan Tool Screen Dimensions:	0.9" x 3.9" (2.2cm x 9.8cm)
Screen Display Characteristics:	4 lines, 20 characters/line, LCD back lit
Power Supply/Voltage Ratings:	12.5VDC, 7.5-16.0VDC
Operating/Storage Temperature:	20°-100°F (-12C- 68C),-10°-120°F (-22-88C)
Price Range:	$980.00 - $1,400.00

Additional Functionality

Heavy Duty trucks with separate cartridge	Data flight recording for data capture

Additional Equipment

Portable printer for hardcopy print-out	Scan/Gas PC software
Optional cables for Heavy Duty Trucks	

Vehicle Coverage

1996 - Current Year OBDII equipped vehicles	1981 - 2000 Chrysler, Ford, and GM (enhanced functions)
Heavy Duty Trucks from 1989 to 2000, for Detroit Diesel, Volvo, Cat., Cummins, Hino, V-MAC, Navistar, GMC, Allison Trans, Meritor/WABCO, Kelsey Hayes, and Eaton	

Toyota Diagnostic Tester
www.spxotc.com
(Follow the Toyota link to "Special Service Tools")

Scan Tool Properties	
Scan Tool Dimensions:	9.7" x 8.7" x 2" (24.6cm x 22cm x 5.1cm)
Scan Tool Weight:	3.3 lbs. (1.5 kg)
Scan Tool Screen Dimensions:	3" x 3" (7.6cm x 7.6cm)
Screen Display Characteristics:	12 lines, 20 characters/line LCD
Power Supply/Voltage Ratings:	9 - 24 V DC, 1 A, NICAD Battery (alternate power)
Operating/Storage Temperature:	32 - 122 / -4 - 140 °F (0 - 50 / -20 - 60 °C)
Price Range:	$ 1,995 - $2,595

Additional Functionality	
Digital Multi-meter	Digital Single- and Dual-Trace Oscilloscope
Noise, Vibration and Harshness Analyzer	Comprehensive electrical system diagnosis

Additional Equipment	
Program Card (required)	Input/Output (I/O) Cartridge
Noise, Vibration and Harshness Kit	Break-out Box Kit
Auto Probe	

Vehicle Coverage	
All OBD II equipped Toyota Vehicles (since 1989)	1994 - Current Year OBDII equipped vehicles

Vetronix MasterTech
www.vetronix.com

Scan Tool Properties	
Scan Tool Dimensions:	9.7" x 8.7" x 2" (24.6cm x 22cm x 5.1cm)
Scan Tool Weight:	2.25 lbs. (1.02 kg)
Scan Tool Screen Dimensions:	3" x 3" (7.6cm x 7.6cm)
Screen Display Characteristics:	12 lines, 20 characters/line (or 20 lines, 26 characters/line), LCD (160 x 160)
Power Supply/Voltage Ratings:	6.5 - 24 V DC, 1 A, NICAD Battery (alternate power)
Operating/Storage Temperature:	32 - 122 / -4 -140 °F (0 - 50 / -20 - 60 °C)
Price Range:	$ 3,195

Additional Functionality	
Digital Multimeter	Digital Single, Dual-Trace, and Ignition Oscilloscope
Noise, Vibration and Harshness Analyzer	Gas Analyzer (PXA series 4, 5)
Comprehensive Electrical System Diagnosis	Non-Contact Infra-Red Temperature probe

Additional Equipment	
Program Card (required)	Application or Mass Storage Cartridge
Noise, Vibration and Harshness Kit	Break-out Box Kit
Ignition Scope Kit	Low Current and Infra-Red Temperature Probes

Vehicle Coverage	
1981 - Current Year Chrysler, Ford, and GM (enhanced functions)	1994 - Current Year OBDII equipped vehicles
1983 - Current Year Asian Imports (enhanced functions)	Heavy Duty Applications: Cummins CELECT, Mack VMAC II and III, Navistar Navpack, and Detroit Diesel DDEC II, III, and IV